CLAIMS

1. A method for implanting ions into a workpiece, comprising the steps of:

generating an ion beam;

measuring an angle of non-parallelism of the ion beam;

performing a first implant with the workpiece oriented at a first angle; and

performing a second implant with the workpiece oriented at a second angle, wherein the first and second angles are opposite in sign with respect to a reference direction and in magnitude are equal to or greater than the measured angle of non-parallelism.

2. A method as defined in claim 1 wherein the steps of performing said first and second implants are controlled to provide substantially equal ion doses in the workpiece.

3. A method as defined in claim 1 wherein the angle of non-parallelism is less than about 5°.

4. A method as defined in claim 1 wherein the angle of non-parallelism comprises a half angle of divergence of the ion beam.

5. A method as defined in claim 1 wherein the angle of non-parallelism comprises a half angle of convergence of the ion beam.

6. A method as defined in claim 1 further comprising the step of generating the ion beam utilizing a parallelizing device.

7. A method as defined in claim 1 further comprising the step of generating the ion beam without utilizing a parallelizing device.

8. A method as defined in claim 1 wherein the reference direction comprises a direction of the ion beam at the workpiece.

9. A method as defined in claim 1 wherein the reference direction comprises a selected implant angle relative to a direction of the ion beam at the workpiece.

10. A method as defined in claim 1 wherein the first and second angles are equal in magnitude.

11. A method for implanting ions into a semiconductor wafer, comprising the steps of:

generating an in beam;

measuring an angle of non-parallelism of the ion beam;

tilting the wafer at a first angle;

performing a first implant at the first angle;

tilting the wafer at a second angle; and

performing a second implant at the second angle, wherein the first and second angles are opposite in sign with respect to a reference direction and in magnitude are equal to or greater than the measured angle of non-parallelism.

12. A method as defined in claim 11 wherein said first and second implants are controlled to provide substantially equal ion doses in the wafer.

13. A method as defined in claim 11 wherein the angle of non-parallelism of the ion beam is less than about 5°.

14. A method as defined in claim 11 wherein the angle of non-parallelism of the ion beam comprises a half angle of divergence of the ion beam.

15. A method as defined in claim 11 wherein the angle of non-parallelism of the ion beam comprises a half angle of convergence of the ion beam.

16. A method as defined in claim 11 further comprising the step of generating the ion beam utilizing a parallelizing device.

17. A method as defined in claim 11 further comprising the step of generating the ion beam without utilizing a parallelizing device.

18. A method as defined in claim 11 wherein the reference direction comprises a direction of the ion beam at the wafer.

19. A method as defined in claim 11 wherein the reference direction comprises a selected implant angle relative to a direction of the ion beam at the wafer.

20. A method as defined in claim 11 wherein the first and second angles are equal in magnitude.

21. Apparatus for implanting ions into a semiconductor wafer, comprising:

means for generating an ion beam;

means for measuring an angle of non-parallelism of the ion beam;

means for tilting the wafer at a first angle;

means for performing a first implant at the first angle;

means for tilting the wafer at a second angle; and

means for performing a second implant at the second angle, wherein the first and second angles are opposite in sign with respect to a reference direction and in magnitude are equal to or greater than the measured angle of non-parallelism.

22. A method for implanting ions into a semiconductor wafer, comprising the steps of:

generating an ion beam;

tilting the wafer at a first angle with respect to the ion beam;

performing a first implant with the wafer tilted at the first angle;

tilting the wafer at a second angle that is equal in magnitude and opposite in sign with respect to said first angle; and

performing a second implant with the wafer tilted at the second angle.

23. A method as defined in claim 22 wherein the step of tilting the wafer at a first angle comprises tilting the wafer at a half angle of divergence of the ion beam.

24. A method as defined in claim 22 wherein the step of tilting the wafer at a first angle comprises tilting the wafer at a half angle of convergence of the ion beam.

25. Apparatus for implanting ions into a semiconductor wafer, comprising:

an ion beam generator;

a measuring system for measuring an angle of non-parallelism of the ion beam; and

a tilt mechanism for tilting the semiconductor wafer at first and second angles, wherein the first and second angles are opposite in sign with respect to a reference direction and in magnitude are equal to or greater than the measured angle of non-parallelism, wherein first and second implants are performed at the first and second angles, respectively.

26. Apparatus as defined in claim 25 wherein said measuring system comprises a movable beam profiler and one or more beam detectors.

27. Apparatus as defined in claim 25 further comprising an ion optical element for parallelizing the ion beam.

28. Apparatus as defined in claim 25 wherein the first and second angles are equal in magnitude.

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